**Bring Your Own Device Movement in  K-12 Education**

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**Abstract**

With the challenge to personalize education, technology has been called on to provide the route to success with Bring Your Own Device policy (BYOD) as the vehicle. Many benefits to BYOD have been found such as providing a one-to-one student to computer ratio, meeting the needs diverse learners, and allowing more independence and creativity in the classroom. Opponents of BYOD argue that differing or lack of personal devices widens the digital divide while wreaking havoc for teachers and Information Technology (IT) departments. While there is the possibility of great financial savings with BYOD, these factors are discussed with the addition of policy suggestions and recommendations for integration.

Keywords:  Active Learner, BYOD, Common Core Standards, Digital Literacy, Digital Divide, E-learners, Smarter Balance, Project Learning Environments, technology, personalized learning, devices

Definition of Terms

**Device** -- any machine or component that attaches to a [computer](http://www.webopedia.com/TERM/C/computer.html). Examples of [devices](http://www.webopedia.com/TERM/D/device.html) include [disk drives](http://www.webopedia.com/TERM/D/disk_drive.html), [printers](http://www.webopedia.com/TERM/P/printer.html), [mice](http://www.webopedia.com/TERM/M/mouse.html), and [modems](http://www.webopedia.com/TERM/M/modem.html) [1].

**E-learners** -- Education via the [Internet](http://www.webopedia.com/TERM/I/Internet.html), [network](http://www.webopedia.com/TERM/N/network.html), or standalone [computer](http://www.webopedia.com/TERM/C/computer.html). E-learning is essentially the network-enabled transfer of skills and knowledge.

**Digital Divide** -- the socioeconomic and other disparities between those people who have opportunities and skills enabling them to benefit from digital resources, especially the Internet, and those who do not have these opportunities or skills: programs that help to bridge the digital divide between rich and poor countries [2].

**Bring Your Own Device Movement in  K-12 Education**

Technology dominates every aspect of our lives from banking to shopping to personal communication; however, there is one place where its potential has not been realized. That place is the K-12 classroom. In fact, both students and teachers use technology less at school than they do at home [3]. According to the U.S. Department of Education’s 2010 report *Transforming American Education*, students are using technology outside of school hours to create their own learning experiences, but the challenge is leveraging that kind of learning to all students to “provide engaging and powerful learning experiences, content, and resources and assessments that measure student achievement in more complete, authentic, and meaningful ways” inside the classroom [4]. The gap between how students are using technology at home and how they are using it in the classroom must be bridged in order for technology to implement personalized learning and transform American education. However, availability is a major obstacle which must be overcome before that bridge can be built.

In order for technology to fully impact education, it must be available for use by students and educators 24/7 at home and at school [4]. This is not going to be achieved as long as technology is not available to all students at all times. Recently, the national ratio of students to computers in the classroom has been reported at 5.3 to 1 [5]. Even states with improved ratios such as Florida and California only boast ratios of 2.75 to 4.7, respectively [6,7]. These statistics are a far cry from the one-to-one ratio demanded for 21st century learning [8]. A major hurdle must be jumped before this ratio can be achieved, and that hurdle is finances.

In the midst of a valiant call for education reform, schools are limited in their technology purchases by the need for cost-effective stratagies [4]. However, there are resources available to schools and students at no cost to the school systems. These devices are owned by the students. By developing policys which allow students to bring and use their own devices in the classroom, educators can meet technology requirements and ignite education reform while staying within the budget [8]. These policys are commonly known as Bring Your Own Device (BYOD), and with these policys, radical reform is within reach.

**Common Core**

The Common Core standards are a state led effort to create a clear framework that will better prepare students for college and the workforce. The consistency of standards across the country will allow students to reach important educational benchmarks regardless of where they live. Students will engage in rigorous study, and through study they will gain knowledge and higher order thinking skills. The Common Core standards require that “students gain, evaluate, and present increasingly complex information, ideas, and evidence through listening and speaking as well as through media” [9]. Students are expected to engage in academic discussion. This is often through informal discussion as students collaborate together to answer questions. The use of media and technology is an integral part in education and the social lives of students; therefore, the Common Core standards integrate critical analysis and production of media.

***How Does BYOD Relate to the Common Core Standards?***

The Smarter Balanced Assessment Consortium is developing the next generation of standardized testing that aligns with the Common Core standards for English Language Arts and Mathematics. The testing will be computer-based and will consist of two parts. The first part is multiple choice questions that are adaptive to the student’s learning level. As students answer questions, the test adapts to their learning level creating individualized tests. This allows the test to be more secure than a traditional paper and pencil test and a more accurate means to determine student achievement. The second part of the test will be a performance task where students will have to critically analyze material to develop a solution for a real world situation. The overall goal is to understand the students’ ability to research, analyze text, and express through writing and speech their thoughts on various topics. The testing can also be done on an interim basis during the year to determine what areas are weak for students. This allows educators to differentiate and modify instruction to meet those students’ needs [10].

The Smarter Balanced Consortium has developed a framework of guidelines and specifications that schools need to adhere to in order to effectively administer the Smarter Balanced computer test. Currently the framework does not include the use of Bring Your Own Devices as a means to take the test. The framework for testing starting in 2014-2015 focuses on having school districts meet the basic hardware and software requirements for their laptops and desk top computers. The framework does allow for districts to plan for the future with the implementation of mobile devices and tablets. The framework calls for school districts to establish new technology initiatives on how computers are checked out, how technology carts are moved class to class and the use of student owned devices. Because the test is secure, Smarter Balanced requires that students take the test on a school computer that has been installed with a secure browser. This prevents screen shots from being taken and blocks students from accessing anything other than the test; however, students with their own devices are allowed to access practice tests from any web browser at home or school. Schools that utilize tablets have to follow strict guidelines in order to use them for testing. The screen must be no less than 9.5 inches, have a revolution of 1024x768 and have the ability for students to type using a plug and play keyboard [10].

***BYOD in the Classroom for Digital Literacy***

In an article by Joe Wood (2012) he analyzed how educators are using digital literacy in their classrooms. Digital literacy is “reading digital text, writing digital text, and developing the technical skills necessary to consume and produce these texts”. Digital literacy is a key component of the Common Core standards and of the Smarter Balance assessments. Schools may not have enough computers for educators to implement digital literacy in their classrooms, but if effectively done students can use their own devices to practice digital literacy. Educators can integrate lesson plans that allow students to create slide shows, post videos, blog, tweet, update on Facebook, and even text. As students engage with technology as part of the lesson, they should transition into being able to conduct research, integrate knowledge, and evaluate the strengths and weaknesses of various technological devices needed to accomplish a given goal. Educators will need to work carefully with students and their devices to help them determine the most appropriate way to share their ideas effectively [11].

The Smarter Balanced System Requirements Specifications

|  |  |  |
| --- | --- | --- |
| Operating System | Minimum Requirements | Recommended New Purchases |
| Windows | Windows XP (service pack 3)  Pentium 233 MHz processor  128 MB RAM  52 MB hard drive free space | Windows 7+  1GHz processor  1GB RAM  80 GB hard drive or at least 1GB  of hard drive space available |
|  |  |  |
| Mac OS X | Mac OS X 10.4.4  Macintosh computer with  Intel x86 or PowerPC G3  (300 MHz) processor,  256 MB RAM, 200 MB  hard drive free space | Mac OS X 10.7+  1 GHz processor  1GB RAM  80 GB hard drive or at least 1GB  of hard drive space available |
|  |  |  |
| Linux | Linux  (Ubuntu 9-10, Fedora 6)  Pentium II or AMD K6-III  233 MHz processor  64 MB RAM  52 MB hard drive free space | Linux  (Ubuntu 11.10, Fedora 16)  1 GHz processor  1GB RAM  80 GB hard drive or at least 1GB  of hard drive space available |
|  |  |  |
| iOS | iPads 2 running iOS6 | iPads 3+ running iOS6 |
|  |  |  |
| Android | Android-based tablets  running Android 4.0+ | Android-based tablets  running Android 4.0+ |
|  |  |  |
| Windows | Windows-based tablets  running Windows 8+ | Windows-based tablets  running Windows 8+ |
|  |  |  |
| Chrome OS | Chromebooks running  Chrome OS (v19)+ | Chromebooks running  Chrome OS (v19)+ |

Information adapted from http://www.smarterbalanced.org/smarter-balanced-assessments/technology/

**Benefits of BYOD**

The use of computer or any other device does not guarantee the learner is going to succeed. The outcome is unpredictable the same way that having books in the library will not guarantee that the learner will learn. Printed books cannot be updated, but the Internet is a world wide web of knowledge that gets updated by the second. The common denominator is the learner who has to engage in his own learning and should not miss out on this valuable resource.

***Who Will Benefit?***

The learners, teachers, and the entire education entity will benefit with BYOD. In education, to see results takes time. It does not happen overnight. Computers, laptops, tablets, cellular phones or any such device allows the user to access, through the Internet, a world of information. In this generation, students are known as *e-learners* and have been *highly motivated* to learn technology in a fear of being left behind. They are not learning the same way previous generations have learned, but are on the move on a 24/7 schedule. This is a mobile generation using mobile equipment and learning in their mobile way. This requires the educators to keep up with them. Technology devices do not need to be connected to the Internet to be useful. It is easy to download material to the device for future use. It takes cognitive knowledge to go from one device to another. Look at the most used software: MSWord. This software allows the user to type, make grammar corrections, re-arrange and modify text, copy, paste, print, and much more. It makes writing easier. The learner and teacher can create activities to interact with another class next door or around the world. These activities can be synchronous or asynchronous which increase opportunities for interaction with others.

***English Language Learners***

Learners who speak English as their second language (L2) can easily connect with other learners whose speak English as their first (L1) language and improve their language skills [12]. In the Turkish Online Journal of Qualitative Inquiry, Güliz Turgut mentions that L2 students can use laptops for five purposes in the classroom: developing and practicing language skills, differentiating reading levels, write essays, preparation and presentation of projects, and completing assignments [13]. While they use the laptops for those purposes, they are also using different software. Some of those tasks can be performed using tablets and be printed with a proper application. Some issues were raised when using laptops to teach L2 students; the lack of software and updates, reliable connectivity and updated laptops [13]. Having connectivity problems can affect any device. The WiFi connection is mainly used but its service has to be reliable. One problem that was encountered is that all programs are written in English.

***Learners with Special Needs***

Learners who have a physical disability can use any of the technological devices and participate in games and other fun activities. Learners who have comprehension problems can review the class material over and over with their own devices. Students with learning disabilities can benefits from assistive technology [14]. The use of technology devices are needed to assist students with learning disabilities in completing the required tasks. For students who cannot read their textbooks, they can benefit from using text to speech programs. There is software that types what the students say, helping them in their writing [14].

***The Active Learner***

Students today have grown up surrounded by technology which has influenced many aspects of their lives. They are classified as active learners because they expect technology to enhance and extend learning inside and outside of the classroom. The active learner wants to have their technology devices daily incorporated into their education. Students want the ability to use their smart phone or other devices to access calendars for assignments, find information using digital media, and interact with the class through social media [15]. Another benefit is students with their own devices can extend and enhance lessons learned in class by downloading educational apps. Currently there are thousands of free educational apps for most mobile devices. Educational apps like Join.me and Voice- Thread allow students to collaborate on school projects outside of school. The Evernote application allows students to add notes to their device, create to do lists, and set calendar reminders for upcoming assignments [16]. Many of these devices and programs are invaluable to the active learner.

***Personal Learning Environment***

Personal Learning Environments (PLE) is the idea that student devices can be used to create an individualized instruction plan that accommodates students’ abilities and interests and moves them towards a higher level of achievement. Educators who support learner-centered education can have students use their devices to create web pages, wikis, and e- portfolios to display their work. This allows for differentiation in instruction and assessment. Another aspect of PLE is the ability to cater reading to students’ interest level and skills. Students who are utilizing software like MyON reader can log into the software from any computer or mobile device. Once they take a Lexile test to determine their reading level, they fill out an interest inventory, and then they can rate previous books they have read. Similar to Netflix, MyOn recommends books that students may like to read. The software allows students to access over 14,000 library books to read online. Students are given formative assessments periodically through reading, and teachers can track student progress. Schools can use software throughout summer to encourage reading over the long break [17]. These are some of the ways that devices can make learning personal.

Schools are realizing the benefits of digital devices in the classroom. In St. Hilda’s School in Queensland, Australia they have allowed all students to used their mobile devices to complete assignments. The result is learning continues outside of the classroom. Students can collaborate and share through devices, and they can get feedback through teachers outside of class. All course work and homework is placed online, allowing students to easily make up work and stay in contact with what is happening in class when they are absent [15].

***Cost Benefits***

One of the benefits of BYOD is the ability for schools to have students use their own devices to do research and class activities. This is especially helpful when schools do not have enough computers in the classroom. Many students in poor communities do not have laptops and desktop computers, but their families often have smartphones. Schools are loading educational programs on the smartphones allowing for students to practice math problems and even write papers. In many schools where there is a lack of computers, students often will spend as little as fifteen minutes a week on the computers. When adopting BYOD policies, schools can allow students more time on the Internet for online learning, class assignments, and research until they can buy or replace computers [18].

One of the main advantages of BYOD is the ability to connect to the Internet, mainly using WiFi. The Internet service must be present for students and teachers to connect. The National Infrastructure Initiative (NIII) created in 1993, had a goal of extending the universal service concept [19]. It will provide poor schools access to telecommunication services. In 1996 the U.S. Congress approved the Telecommunication Act (E-Rate) to provide discounted services to poor districts. It is limited to schools and libraries that cannot provide resources for their community organizations [20]. The E-rate uses the school socioeconomic status system to measure their financial support. For example if the school had 70% of students in reduce lunch, E-Rate would provide 70% of the connection cost. Other non-profit organizations like CTCNet have come together to provide access to technology [19].

**CTCNet’s Mission:**

CTCNet believes that all people, regardless of race, religion or social status should have equal rights and access to technology and the ability to learn the skills to use it. It was founded by the Playing to Win foundation. They understood even in the late 90’s that technology was moving fast. It was going to become a staple to everyday life and that people who did not have the ability or advantage of using and learning these technologies would sooner or later get left behind in a sea of ever-advancing technologies [19].

Having E-Rate combined with CTCNet makes Internet access to less affluent schools district possible, closing an economic gap to have access to telecommunication. The problem is not solved here. It takes more than connectivity to make the connection. It requires devices and updated software. Also, the schools districts need to have the leadership and teachers’ preparedness to deal with technology devices.

Sarah Bernard raises a question on her article “Crossing the Digital Divide: Bridges and Barriers to Digital Inclusion” on how to define access when the prices on personal computers are dropping. She cited “Pew Internet & American Life Project” report saying that 95% of Americans between the ages of 18 to 29 use Internet [21].

A survey conducted by the Advanced Placement (AP) and the National Writing Project (NWP) finds that digital technology help middle and high schools students. The report also found some remarkable difference between affluent and poor schools [21]. These are the PEW report findings:

* 92% of the interviewed teachers say that Internet has a “major impact” in their ability to access content, resources, and materials for their searching
* 69% say the Internet has a “major impact” on their ability to share ideas with other teachers
* 67% say the Internet has a “major” impact on their ability to interact with parents
* 57% say has such an impact enabling their interaction with students

“At the same time 75% of AP and NWP teachers say the Internet and other digital tools added new demand for their lives. Forty-one percent report that major impact by demand by enabling more interaction with the students” [21].

The survey found that digital tools are widely used in classrooms and assignments; however, it also indicates that teachers of the lowest income students face more challenges in bringing these tools to their classrooms:

* 52% of teachers of upper and upper-middle income students say their students use cell phones to look up information in class, compared with 35% of teachers of the lowest income students
* Just 15% of AP and NWP teachers whose students are from upper income households say their school is “behind the curve” in effectively using digital tools in the learning process; 39% who teach students from low income households describe their school as “behind the curve”
* 70% of teachers of the highest income students say their school does a “good job” providing the resources needed to bring digital tools into the classroom; the same is true of 50% of teachers working in low income areas
* Teachers of the lowest income students are more than twice as likely as teachers of the highest income students (56% v. 21%) to say that students’ lack of access to digital technologies is a “major challenge” to incorporating more digital tools into their teaching [21].

A reasonable way to close the gap among the poor and affluent students is by the school to provide devices to be shared in classrooms. Students that do not have Internet connection at home can visit the public library or stay after hours in school to complete their work. In fact, many school districts are mapping out local areas to show students where there are free hot spots [22]. Noting that over 92% of college students use the Internet, future college students need to be proficient in the use of the Internet devices. BYOD is what most college students are doing, because their college does not provide devices. K12 students can benefit from the use of BYOD to conduct researches and produce class work preparing them for the future.

**Disadvantages of BYOD**

***For Students***

Gary Stager, the director of the Constructing Modern Knowledge Institute, believes “BYOD is a bad policy that constrains student creativity, limits learning opportunities, and leads to less support for public education in the future” [23]. Stager believes that BYOD creates inequality in the classroom because affluent students will gain an unfair advantage over their classmates with their personal devices. Stager argues that many devices are much less powerful than desktop and laptop computers, so students are wasting time on them when they can be engaging with better hardware and software that is geared for education[23]. Another disadvantage to BYOD is the distraction that can be created if students use their devices to access inappropriate material without teacher knowledge. Educators have to constantly monitor to make sure students to do not bring inappropriate images, videos, and texts into school. Also, students can download material and apps that could be used to cheat in class [24].

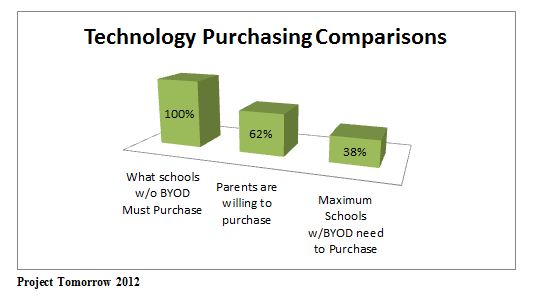
***Equity in BYOD***

One the biggest arguments against BYOD movement is providing an equitable education to a diverse population of students which each have different devices or no devices at all [22]. Opponents such as Stager call BYOD the “Worst idea of the 21st century,” and state inequity between affluent students and their classmates as the primary reason [25]. Johnson answers Stager’s concerns by explaining how classrooms can have significantly better student to computer ratios by allowing student owned devices into the classroom [26]. In the initial rebuttal to the claim of inequity among devices, the resounding claim is that having diversity in devices is better than not having enough devices. In an effort to meet the National Educational Technology Plan by ensuring every student has an Internet connect device for use “in and out of school,” educators must use untraditional methods to supply technology [4]. In Project Tomorrow, the mobile device is claimed as “the great equalizer of access,” which is a stark contrast to being a cause for inequality [27]. Proponents of BYOD offer many solutions to the possible disparity between devices as well as evidence that the diversity between student-owned devices may not be great.

Although equity in devices will not be achieved when students bring their own devices, there is power in diversity and the result can be collaboration. In fact, Forsyth County educators report increased collaboration in the BYOD classroom because of differentiating devices which has been labeled the “BYOD huddle” [22]. Students are encouraged to work together, using appropriate devices for each assignment. This fosters collaboration which is at the heart of many technology initiates [4].

The number of students with access to Internet devices has been steadily growing, even among low-income populations. In schools designated as low-income, 61% of parents said they would purchase a mobile device if their child could use it for instructional purposes while 62% of all parents would do the same [27]. This diversity is small. Currently, 50% of 9th to 12th graders report that they already own a smartphone, while 21% have a tablet [27]. The main obstacle for these students seems to be that they cannot use these devices at school. These statistics show that if devices are allowed, parents would help fund the majority, leaving districts to supply less than 40%. According to The NMC Horizons Report, educational institutions around the world are supplying devices to students who do not have them [28]. With the decreased number of devices funded by the schools, providing students with a one-to-one student to computer ratio could be a financial possibility for most school districts.

When parents do not provide their children with devices, the answer is for schools to use available resources to purchase for those students. Costa presents BYOD as a solution for schools that struggle to provide computer to their students [8]. He claims that 60 to 80% of students can afford to provide their own computers, and that the school system should provide for the remaining percentage. He claims that this can be done by switching from licensed software to free software, stating that the free software can do 90% of what the licensed software is doing [8]. In addition to this financial savings, schools can save money by changing from printed texts to digital texts. By combining both of these savings, schools would be able to fund computers for those students who cannot provide their own. The savings from purchasing fewer devices will help narrow inequity among student-owned devices. This makes BYOD the best way to leap into full digital learning.



***For Educators***

Stager believes that BYOD increases the anxiety of teachers in their responsibility to monitor students with all different devices [25]. Educators often are not provided adequate professional development for how to implement BYOD. In schools that provide devices for students like iPads, many teachers have no training, but their own personal experience with the device that was just recently given to them. Personal experience with an iPad will not lead to expertise in a work. Research has shown that educators tend to use new technologies to fit into their existing lessons [3]. If educators are not given time to collaborate and learn the benefits of devices, then how are expected to use these devices effectively? The devices can differentiate instruction for students, and there are a wide range of apps and web tools that are available for teachers. Unfortunately, without adequate training, they may not be aware of their existence. Educators also need to be given instructions on how devices can be used in the class. Teachers need to know the guidelines that exist for students sharing material through devices, collecting work done on a device, and grading procedures. This can be complicated and time consuming [29]. Educators that plan lessons around BYOD may face many challenges in their lesson. Teachers may have to deal with students forgetting to charge their device, troubleshooting technical problems, and students bringing devices that pose a threat to the overall network [30]. These factors can cause difficulty in the adaption of BYOD for instructors.

***School Districts***

Raths researched the impact of Bring Your Own Device movement on school districts in the United States [31]. For his research, he interviewed technology coordinators, faculty and staff to determine the keys to BYOD readiness. His research took him to Hanover school district in Pennsylvania, Jordan school district in Utah, Park Hill school district in Missouri, and an Episcopal Academy in Florida. In each district Raths wanted to determine how BYOD was implemented and what the results were. Each district had problems and difficulties when first adopting a BYOD policy.

Hanover school district had established wireless access points for laptops in their schools five years before BYOD. When BYOD was implemented into the school district, they quickly realized that they would have to add more access points. The district decided to establish two separate networks one for BYOD wireless devices and one for school devices. The downside is students cannot use their own device to print material since they are not connected to school hardware. In the Jordan School district in Utah, they encountered early problems with BYOD because each school in their 50,000 student district was responsible for establishing their own wireless infrastructure. When BYOD was implemented, new wireless routers were placed in schools by teachers which led to radio frequency interference. The Park Hill school district in Missouri decided that the key to BYOD was to upgrade their Cisco Network. This was at a heavy cost; they had to spend 1.3 Million dollars to buy new switches and allowed them to establish 750 access points in their 19 facilities. Brad Sandt the director of technology explained that the network is constantly changing, so planning should be done on a continual basis not as a one -time project [31]. For each of these districts, adapting to BYOD took a lot of effort.

**IT Concerns**

School district IT departments all have one thing in common…they never seem to be able to keep up with the times. This creates a major issue when it comes to managing computers and technology in general. Technology moves faster than the average school district technology budget allows for expansion of equipment. The real answer to this issue may be BYOD.

The impact of this initiative on the IT departments in school districts can cause havoc if not correctly planned for and implemented. One of the biggest concerns is the impact on the current infrastructure in place. Most IT departments are set up to handle a set number of computers with Internet access and those same machines to have login accounts for teachers, students, and staff that all have set permissions and allowances in the school computer system.

The major impact on IT is the level of preparedness. Some school districts are more than prepared and can begin implementation in a very short time frame; while others are caught completely off-guard and require massive changes in infrastructure before BYOD can be implemented.

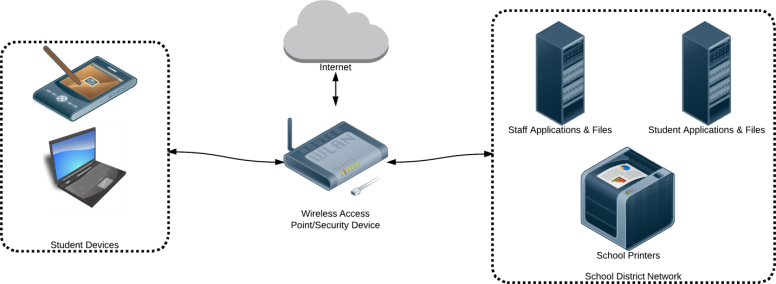
**Implementation of BYOD**

In order to implement BYOD, a school district needs to have their infrastructure in a configuration that will allow access to Internet, applications, and file resources on the school network. Most schools today allow students to log on to their computer system from school-owned machines on campus, while not allowing students to use their own computers on the school network at all. The major configuration changes come from network upgrades to handle the increase in student users on the Internet and also an access gateway that allows students to log on to the school network and get access to applications and school resources from anywhere there is Internet access [32].

***Internet Requirements***

Back in the late 1990's and early 2000's, it was the gold-standard to have Ethernet wired in to every classroom and student area on campus, and at least a couple computers in every classroom. Since the widespread implementation of wireless Internet access (WiFi), computers have become more mobile, where teachers use laptops in place of desktops, and students now bring tablet computers to class in place of textbooks. This change in Internet availability has driven the entire market of mobile devices, which has given birth to the BYOD initiative. Students now own the mobile devices that allow them to succeed in the classroom, and the Internet that is made available to students needs to be of sufficient speed to allow them to view video, animations, and other applications that will allow them to succeed in the classroom. Teachers also need this bandwidth to allow them to make these teaching tools available to their students.

**Network Access**



In order for students to have access to all of the applications and files that they are used to on the school-owned machines, their login profiles need to be accessible from a BYOD device. This requires access software. This software allows IT to apply user profiles and passwords to be able to log in from a website. Once logged on to the network, students have the ability to get their schoolwork from anywhere they have Internet access. What makes this even better is that students and teachers can log on to the school network from anywhere in the world as long as they have Internet access [32].

# ***Security***

The biggest issue with BYOD is most certainly security: security from viruses and hacking, security of student and teacher data, and security of the school network. All of these concerns are usually what frighten school administration from implementing BYOD. The security risks are just too high. What makes this point so valid are two major issues that fall under security: student personal information leaks and security of internal resources from viruses and hacking attacks.

There are several approaches to security that can be taken, the first of which is actually quite simple. The school keeps track of the student devices from their media access control address, or MAC address, and allows students to use their devices in class. The MAC address is unique to every device that accesses the Internet all over the world. This allows schools to keep track of who has access to what since the MAC address precedes all signals sent from a computer on a network [34].

The second option is more robust than tracking MAC addresses, and it involves re-architecting some of the school networks to allow…network segmentation. Basically, a completely separate network is created in the school for the students. The student network has all of their personal file folders and their school applications, and on the other network is where the faculty and staff materials are, along with student records and school records as well. This is a more comprehensive approach since the Internet access that students use is different from the Internet access that is available to the faculty and staff [34].

The final option is an amalgamation of the previous two options. Student register their machines on the school networks with the MAC addresses and are then tracked on their own segregated network while they are at school on their own network.

# **Guidelines for using BYOD**

The use of a privately owned electronic device is to support and enhance instructional activities. No student shall use any computer or device to illegally collect any electronic data or disrupt networking [35]. According to J.E. Turner Elementary School, the use of technology provides some unique learning experiences that are unavailable through traditional teaching methods [36]. J.E. Turner guidelines indicated that mobile technologies provide affordances to learners such as the ability to communicate and collaborate over distances through blogging, social networking, and digital learning environments, a large library of e-books for reading on the go, and promote critical thinking and creativity through knowledge sources such as video clips, blogs, websites, wikis and educational applications [36]. When implementing guidelines for BYOD policy everyone must be clear on what is expected when using their own devices. Students must take the responsibility of their own personal devices. When students use their own personal device in schools, they may use them for research, blogging, project-based learning, Edmodo, wikis and much more. There are many resources students can use on their device for instructional purposes only. School districts that require students to use the BYOD policy should have students and parents sign a user agreement which would validate their understanding of the policy agreement. Guidelines that school districts implemented must be followed in order for the BYOD policy to be successful.

With the integration of technology, BYOD policy will continue to expand to help with funding, and the accountability of students using technology in the classroom. BYOD gives students the accountability to take care of their own devices and be comfortable in using their devices for instructional purposes. Technology has changed the way students learn and also changed the way teachers teach inside the classroom. BYOD may benefit schools but they must lay down the ground rules in order for this policy to be effective. Overall, BYOD can be a great way for students to use technology in the classrooms by using their own device. In order for BYOD to be effective, school districts must ensure that there is an effective plan in place and have an ongoing plan in case of technical issues.

**A BYOD Application**

In an effort to more effectively meet the needs of a diverse population of learners, a teaching method which has recently emerged is that of flipping the classroom. With their beginning in 2007, Jonathan Bergmann and Aaron Sams have pioneered this teaching movement including the flipped-master model and given advice for making it work [37]. After observing the struggles of many students such as those with unavoidable, excessive absences or those needing extra explanations, they realized that they could offer more to their students if they could individualize their time in the classroom and provide instruction as part of the course homework through videos. In this model, the teacher-directed instruction becomes the homework, and classroom time becomes student-centered [38]. Both of these models depend upon the use of technology at home and in the classroom. Some of the uses of devices include watching video lessons, completing interactive activities, and taking computerized assessment which provides instant feedback. Students are even able to watch their lessons while riding the bus to their track meet in the next town. BYOD would provide a practical resource for students in a flipped classroom and help implement student-centered learning by allowing them to use the same device at school, home, or on the road.

**Summary**

Even though the concept of BYOD has only recently emerged, it is quickly becoming a hot topic in an attempt to meet the need for technology in the education. Many authors have provided evidence that BYOD can help districts save money while providing one-to-one device access for students and serving students with special needs. However, many concerns have been raised such as how to make sure there is device equity, provide adequate infrastructure to meet the Internet needs, and develop appropriate policy and security. What is missing in the literature is research that shows how BYOD actually changes the way students learn by using more technology inside the classroom. School districts who implement BYOD policies must ensure that they plan effectively to meet with challenges they may face along the way and help improve learning for all students.

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